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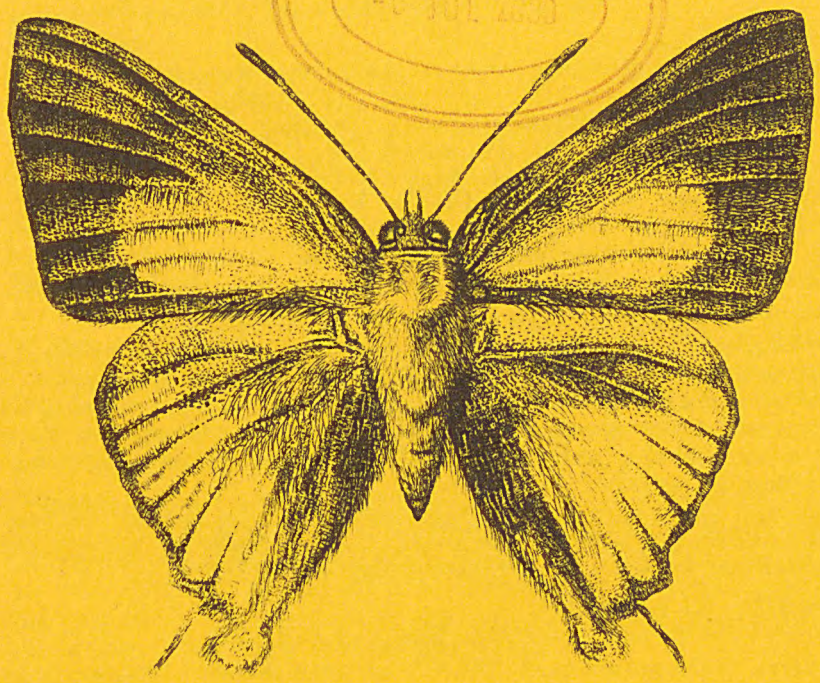

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Cover: The cornelian butterfly, *Deudorix epijarbas* (Moore) is distributed from Cape York, Qld south to the Gosford area, N.S.W. The male is strikingly coloured orange-red and black above and pale brown below. The larvae feed within the seed capsule of several rainforest plants, including *Harpullia, Macadamia* and *Buckinghamia.* From an original etching by Geoff Thompson.

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NESTING BIOLOGY OF THE AUSTRALIAN STEM-NESTING WASP *RHOPALUM BENDORENSE* LECLERCQ (HYMENOPTERA: CRABRONIDAE)

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Abstract

Female *Rhopalum bendorense* Leclercq excavated 1.5-2.5 mm diameter burrows in recently exposed pithy green stems of various shrubs during January to March 1999 in Canberra, ACT. Burrow length averaged 55 mm (range 19 to 105 mm). Prey comprised six families of flies and two families of adult Psocoptera; Diptera predominated 4:1. Females practiced modified mass provisioning; the egg was laid transversely on the prothorax of one of the first several prey, with additional prey provided (up to 41 total) by the time the larva began to feed, at which point the cell was closed with a partition of compact pith. In two of the 14 active nests more than one female was present, but their relative contributions were unknown. No parasitoids were reared and there appeared to be two overlapping generations. Reared sex ratio from the first generation was about 2:1 female biased.

Introduction

Rhopalum Stephens is found world-wide with 109 species listed by Bohart and Menke (1976). Until recently only 32 species were known for Australia, but Leclercq (1997) described 66 new species from Australia, placed into 19 species groups. Surprisingly little has been published on the nesting behaviour of Australian species. Rayment (1932) recorded *R. verutum* Rayment nesting in reeds, often 'renting' cells of a bee and preying on flies. Evans and Matthews (1971) described the biology of a soil nesting species, *R. variitarse* Turner, also a specialist on various flies. Leclercq (1997) noted that Australian species are known to nest in soil, twigs and wood, and reported an unusual prey of a winged ant pinned with a female *R. carnegiacum* Leclercq from New South Wales. Studies of *Rhopalum* species elsewhere (e.g. Krombein 1964, Kislow and Matthews 1977), indicate that members of the genus nest in pre-existing cavities in stems, galls and beetle burrows and prey on flies or Psocoptera.

Rhopalum bendorense Leclercq was described from two specimens, a single female from Bendora, A.C.T. (holotype) and a paratype female from Collinsville, Tasmania (Leclercq 1997). This species is not closely related to any other Australian species and is the sole member of its species group (Leclercq 1997). I present here the first biological data for *R. bendorense*, including description of the nests and prey records.

Methods

Female *R. bendorense* were first encountered on 25 January 1999, when three females were found resting in an unidentified pithy stem in Deakin, a suburb of Canberra, Australian Capital Territory. Subsequently, 22 nests were collected at three A.C.T. sites between January 25 and March 3, 1999. All nests were collected during the day and split lengthwise to reveal their contents. Prey were preserved in 70% ethanol. After nest architecture and cell contents were recorded, nests were individually stored in plastic boxes

and checked daily for emergences. Voucher specimens of wasps and prey have been deposited in the collections of the Australian National Insect Collection, CSIRO, Canberra and the Australian Museum, Sydney.

Results

In all, the 23 nests contained a total of 40 cells. All nests were incomplete, and most were recently initiated, many either being excavated or containing partially provisioned initial cells. One of the nests contained two females and another contained three females. It was apparent that the females actively excavate the soft pith from green stems to form their nests. Recognised nesting plants were honeysuckle (*Lonicera* sp.), hydrangea (*Hydrangea* sp.) and rose (*Rosa* sp.).

Nest burrow diameters ranged from 1.5 to 2.5 mm. Burrow lengths ranged from 19 to 105 mm (average 55 mm). Cell lengths varied, but most ranged between 5 to 12 mm. All nests were in slender green stems 3 to 5 mm in diameter that had been recently pruned, exposing the pith. Partitions between cells appeared to consist of tiny bits of chewed plant pith fibres tightly compacted to 1 to 2 mm thick. The largest nest contained six cells, three recent and three apparently older.

Table 1. Prey taken from 14 nests of *Rhopalum bendorense* in Canberra, ACT.

Order and Family	Species	Number
Diptera		
Drosophilidae	*Drosophila* sp.	6
Chloropidae	sp. 1	3
Chironomidae		
Orthocladiinae	*Procladius squamiger*	2
	prob. *Austrocladius* sp.	6
	sp. 1, not *Austrocladius* sp.	1
Chironominae	prob. *Polypedium* sp.	1
	four additional unidentified spp	7
Ceratopogonidae	*Culicoides* sp.	1
	three unidentified spp.	10
Sciaridae	? *Bradysia* sp.	30
	sp. 1, not *Bradysia* sp.	5
Cecidomyiidae	sp. 1	1
Unidentified Diptera		4
Psocoptera		
Caeciliidae	*Enderleinella* sp.	3 ♂, 3 ♀
Ectopsocidae	*Ectopsocus briggsi* McLachlan	1 ♂
	Ectopsocus punctatus Thornton & Wong	8 ♂, 1 ♀
Unidentified Psocoptera		5

Prey (n = 98) were obtained from 14 nests (Table 1). All belonged to the Diptera (six families represented) or the Psocoptera (two families represented). Diptera were the predominant prey (n = 77), but cells in six

nests contained both flies and psocids. Six nests had flies only and in two nests only psocids were found. Typically, prey were placed head first or were sideways in the burrow and not tightly packed. Prey were profoundly paralysed, only able to twitch a leg if touched.

The egg is laid on the venter of the thorax or between the head and prothorax ('neck') of one of the first few prey items stored. The egg is attached by its cephalic pole and is transverse to the longitudinal axis of the prey item. Some nests contained up to 7 prey with no egg, while others contained only a single prey with an egg attached. Two measured eggs were 1.2 x 0.3 mm and 1.25 x 0.37 mm in size.

The single completely provisioned cell contained 37 flies and 4 psocids, with a newly hatched larva. This cell was not yet closed, but there was a pile of pith particles accumulated adjacent to the last prey, which suggested that cell closure was being initiated. Small feeding larvae were encountered in several other unclosed cells, suggesting delayed mass provisioning. Cocoons were parchment-like and opaque. Bits of prey remains were often incorporated. Eleven female and five males *R. bendorense* were reared from five nests. Progeny in the remaining nests entered diapause and none had emerged by the time the study was terminated in May 1999. No parasitoids were found or reared.

Discussion

The possibility of cooperative nest sharing is suggested by the discovery of two nests with more than one female present. Because nests were collected during the day when adults may have been away from their nests, it is possible that this behaviour is more common than was documented here; it certainly merits further study. Because nests are excavated in pithy stems, cooperation in the early stages of nesting would likely reduce the time required to establish nests. Additionally, cooperation may reduce losses due to parasitoids and predators, although parasitoids that attack after cell closure by oviposition through the stem from the outside would not likely be deterred.

Excavation of nests in plant stems is not universal in stem-nesting *Rhopalum.* Other species appropriate pre-existing cavities, such as those initially made by bees (Rayment 1932, Kislow and Matthews 1977). The absence of any parasitoids reared in this sample is striking, given that other species of stem-nesting wasps studied concurrently were frequently attacked (Matthews, in press).

While the paucity of material in existing collections suggested *R. bendorense* to be relatively rare, this species is actually quite common locally, as Krombein (1964) found for the hibiscus wasp, *R. coarctatum* (Scopoli) [the synonym *Euplilus modestus* Rohwer was used by Krombein]. In my samples of various pithy plant stems, this species was the most frequently encountered. Two species of *Nitela* (Matthews, in press) and one of

Arpactophilus were the only other sphecids found nesting concurrently in the same stems, but these two species were much less common.

It appears that there are at least two generations per year in the Canberra area. However, evidence for this is circumstantial, based on the fact that progeny from nests collected in late January emerged by late February, whereas progeny of the nest collected in early March had entered diapause.

Rhopalum bendorense appears to be an opportunistic predator on a range of lower Diptera and Psocoptera. However, individuals did tend to specialise. For example, all but one of the *?Bradysia* sp. were found in a single cell. Several of the fly prey are swarm-mating species and it seems likely that *R. bendorense* females capture prey from such aggregations. Interestingly, all of the psocid prey were adults and both sexes were evenly represented. According to C. Smithers (pers. comm.) the Ectopsocidae nearly all live in leaf litter or in dead leaves hanging from trees or shrubs, often concealed in curled leaves. Caeciliidae are usually encountered on the undersides of green leaves. Because the flies may be taken from mating aggregations, it seems possible that the psocids were taken in similar circumstances. The *Nitela* nesting concurrently in the same habitat also preyed on psocids, but captured exclusively nymphs belonging to different families which are gregarious bark dwellers. Also, the nymphs were only lightly paralysed, whereas the adult psocids taken by *R. bendorense* were profoundly paralysed.

Acknowledgments

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FEEDING ON LARVAE OF *DANAUS PLEXIPPUS* (L.) (LEPIDOPTERA: NYMPHALIDAE) CAUSES MORTALITY IN THE ASSASSIN BUG *PRISTHESANCUS PLAGIPENNIS* WALKER (HEMIPTERA: REDUVIIDAE)

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Abstract

Adult and nymphal assassin bugs, *Pristhesancus plagipennis* Walker, fed second/third instar larvae of *Danaus plexippus* (L.) died after *ca* 20 and 11 days respectively, after consuming 34.4 larvae (adults) or 10.6 larvae (nymphs). No bugs died when fed on mealworm *Tenebrio molitor* (L.) larvae. It is concluded that cardiac glycosides sequestered by *D. plexippus* larvae from its milkweed host plant, *Asclepias fruticosa* (L.), were progressively accumulated within *P. plagipennis*, resulting in bug mortality.

Introduction

Pristhesancus plagipennis Walker is a large (2-2.5 cm), common Australian assassin bug that is an important generalist predator of a number of insect pests of citrus and other crops in northern New South Wales and Queensland. In citrus it feeds on caterpillars, stink bugs, mealybugs, aphids, beetles and katydids (Smith *et al.* 1997). James (1994) showed *P. plagipennis* consumed up to 154 prey items during development and the long lived adults (James 1992) consume 1-2 prey daily (James, unpubl. obs.).

Field and laboratory observations indicate that *P. plagipennis* readily attacks and feeds on larvae of the monarch or wanderer butterfly, *Danaus plexippus* (L.). *D. plexippus* is an aposematic species which sequesters cardiac glycosides from its milkweed (Asclepiadaceae) foodplants as a defence against vertebrate predators (Reichstein *et al.* 1968, Brower 1969). The ecology of vertebrate predation on adult *D. plexippus* and palatability has been extensively studied in North America and Mexico (Malcolm 1991, Wells and Wells 1992 and references therein). However, relatively little attention has been paid to the impact of invertebrate predation on *D. plexippus* adults or larvae, despite evidence it may occur at significant levels in some habitats. For example, yellowjacket wasps *Vespa vulgaris* (L.) and the dragonfly *Hagenius brevistylus* Selys have been recorded preying on adult *D. plexippus* (Leong *et al.* 1990, White and Sexton 1989). Urquhart (1960), Smithers (1973) and Zalucki and Kitching (1982) reported lacewing larvae, ants, spiders, predatory bugs (Pentatomidae, Reduviidae), sphecid wasps, cockroaches, ladybirds and mantids, as confirmed or potential predators of *D. plexippus* larvae. Although the cardiac glycosides sequestered by *D. plexippus* are vertebrate 'heart poisons', they have the potential to be toxic to invertebrates which have not developed a detoxification mechanism (Whittaker and Feeny 1971). Oleander aphids

Aphis nerii Boyer de Fonscolombe reared on milkweed, caused disruption to predatory behaviour and web building when fed to spiders, but did not cause mortality. There are no published studies of adverse impacts on invertebrate predators caused by feeding on *D. plexippus*.

This study describes apparent cardiac glycoside-induced mortality of *P. plagipennis* when provided with a diet of *D. plexippus* larvae.

Materials and Methods

Pristhesancus plagipennis used in this study were obtained from laboratory colonies initiated from adult bugs collected in southern Queensland and maintained at the Yanco Agricultural Institute in southern New South Wales, where the experiments were conducted. *D. plexippus* larvae were reared on *Asclepias fruticosa* (L.) from eggs laid in captivity at Yanco by butterflies collected in Sydney (1990) or southern Queensland (1998).

Experiment 1(1990)

Twelve second instar, 12 fourth instar and 12 adult *P. plagipennis* were caged separately in plastic cups (10 cm diameter) with muslin lids and held at 25 ± 1° C under a 15 h photophase. Commencing on 12 June, half of each cohort was provided with larvae of *D. plexippus* as prey. Adult bugs (three males, three females) were fed three second or third instar larvae and nymphs were fed two larvae daily. A few leaves of *A. fruticosa* were supplied as food for the larvae. The remaining six bugs in each cohort were each supplied with three mealworm *Tenebrio molitor* L. larvae daily. All bugs were fed on a diet of mealworms and *Drosophila* sp. prior to the experiment. The number of consumed *D. plexippus* and *T. molitor* larvae was recorded for each bug and carcasses removed daily. No other food was provided. The longevity of each bug was recorded.

Experiment 2 (1998)

Following the same protocol as Experiment 1, six third instar nymphs of *P. plagipennis* were provided with one to three third instar larvae of *D. plexippus* daily, commencing on 7 October. Six third instar nymphs were provided with two mealworm larvae daily. Prey consumed and bug longevity were recorded for each bug.

Results

All bugs fed larvae of *D. plexippus* in the two experiments died after mean periods of 20.2 ± 1.2 (adults) and 10.6 ± 0.7 days (nymph data combined) (Table 1). Adults consumed an average 34.4 ± 1.9 larvae before dying, whilst nymphs (combined data) consumed an average of 10 ± 2 larvae (Table 1). There was no apparent diminution in the propensity of *P. plagipennis* to feed on *D. plexippus* larvae during the experiments. No adult or nymph of *P. plagipennis* died during these experiments when fed on mealworm larvae.

Table 1. Longevity and prey consumption by *P. plagipennis* when fed second/third instar larvae of *D. plexippus*. No mortality occurred in corresponding cohorts of *P. plagipennis* fed larvae of *T. molitor*.

Stage of *P. plagipennis* (n)	Mean (± SE) longevity (days)	Mean (± SE) number of *D. plexippus* larvae consumed
Experiment 1		
Second instar (6)	10.8 (0.9)	10.6 (0.8)
Fourth instar (6)	12.0 (1.5)	11.0 (1.8)
Adult (6)	20.2 (1.2)	34.4 (1.9)
Experiment 2		
Third instar (6)	9.0 (1.0)	8.7 (0.6)

Discussion

These results indicate that *D. plexippus* larvae are toxic to *P. plagipennis*. Oyeyele and Zalucki (1990) recorded cardiac glycoside levels of 119-719 µg/0.1 g (mean = 345 µg/0.1 g) of plant material dry weight (DW) in *A. fruticosa*. *D. plexippus* larvae feeding on this milkweed would therefore contain significant concentrations of cardiac glycosides. Thus, it is likely that the mortality of *P. plagipennis* in these experiments can be attributed to progressive cardiac glycoside poisoning.

Adult *P. plagipennis* took about three weeks to die when fed on a diet of *D. plexippus* larvae, whilst nymphs succumbed in half this time. Therefore it is unlikely that occasional predation of *D. plexippus* larvae by *P. plagipennis* would affect field survival of this predator. Presumably, utilisation by *P. plagipennis* of a mixed diet (as is normal for this generalist predator) would minimise the adverse effects of consuming an occasional larva of *D. plexippus*. Further, it is possible under natural conditions that *P. plagipennis* would avoid or reject *D. plexippus* larvae as prey, after feeding experience.

The significance of this study is that cardiac glycoside sequestration in *D. plexippus* has the potential to provide chemical defence against invertebrate as well as vertebrate predators. However, this would only occur if invertebrate predators 'learned' to reject or avoid *D. plexippus* larvae. Further research should be aimed at determining whether this can occur under natural conditions. In this study, *P. plagipennis* had no choice but to feed on *D. plexippus* larvae; the provision of choice between toxic and non-toxic foods might allow the development of avoidance or rejection behaviours. Cardiac glycoside-based defence is likely to work best against generalist invertebrate predators with no specific detoxification mechanisms (Bernays and Cornelius 1989). Thus, the reported predators of *D. plexippus* larvae (e.g. stink bugs, spiders, mantids, lacewings and ladybirds) are all likely to be susceptible to cardiac glycoside poisoning, if a sufficient number of larvae are eaten. In the case of ants, *D. plexippus* larvae would be shared

between many individuals, thus preventing or minimising toxicity to individual ants. Cardiac glycoside poisoning of invertebrate predators of larval *D. plexippus* may be more acute on some North American and Mexican milkweeds which contain greater concentrations of cardiac glycosides than *A. fruticosa* (e.g. *Asclepias linaria* (L.) contains an average 3369 µg/0.1 g DW: Zalucki *et al.* 1990).

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NOTES ON *DEUDORIX* HEWITSON IN THE SOLOMON ISLANDS, THE BISMARCK ARCHIPELAGO AND NEW GUINEA, WITH DESCRIPTIONS OF NINE NEW TAXA (LEPIDOPTERA: LYCAENIDAE)

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Abstract

Nine new species of *Deudorix* Hewitson are described from the Solomon Islands, the Bismarck Archipelago and the island of New Guinea: *D. confusa* sp. nov. (Choiseul and New Ireland); *D. emira* sp. nov. (Bismarck Archipelago); *D. brilligi* sp. nov. (Choiseul); *D. tenebrosa* sp. nov. (Papua New Guinea); *D. parsonsi* sp. nov. (Irian Jaya and Papua New Guinea); *D. mulleri* sp. nov. (New Ireland); *D. rathsi* sp. nov. (Papua New Guinea); *D. eagon* sp. nov. (Choiseul); *D. wabens* sp. nov. (Guadalcanal). Diversity of *Deudorix* in the Solomon Islands is considered and the female of *D. viridens* Druce is newly recorded. 'Blue' species previously placed in *Virachola* Moore are placed with *Deudorix* and the status of *D. affinis* Rothschild, stat. rev. from Papua New Guinea is discussed. It is suggested that evidence to support historical association of a male from Sudest I. with the female holotype of *D. affinis* from Dampier I. is inconclusive.

Introduction

Deudorix Hewitson, a genus of some 60 described species (including those previously placed in *Virachola* Moore), occurs from the Afrotropics, through the Indo-Australian region, to the islands of the western Pacific, including the Solomon Islands, Vanuatu and Samoa. The type species of *Deudorix* is the widespread *D. epijarbas* (Moore), which occurs throughout the Indo-Australian Region, from Sri Lanka and India eastwards through southeast Asia to the Moluccas, northern Australia and the Bismarck Archipelago. It reaches the Solomons Archipelago on Bougainville (Parsons 1998). In his monograph of New Guinea butterflies, Parsons (1998) divided New Guinea *Deudorix* into two groups and reported seven species of the *epijarbas* species-group from Papua New Guinea. Three of these, referred to as '*Deudorix* species a, b and c', represented undescribed taxa and detailed descriptions provided by Parsons included line drawings of the male genitalia and colour illustrations of adults. In order to allow comparisons with further new, closely related, butterflies from the Solomon Islands, it has been necessary to provide these taxa with names.

Treatment of the closely allied genus *Virachola* has varied between authors. In his work on the African lycaenid genera, Stempffer (1967) acknowledged the close similarity between *Deudorix* and *Virachola* and Eliot (in Corbet and Pendlebury 1992) suggested the latter was 'doubtfully separable from *Deudorix*'. The two have been treated as synonymous (e.g. Bridges 1988) and recently Ackery *et al.* (1995) placed *Virachola* as a subgenus of *Deudorix*. Although Parsons (1998) retained both names, he acknowledged

that they were probably synonymous. It is clear from their morphology, structure and early stages that they are very closely allied and *Virachola* is treated here as a synonym of *Deudorix* at the generic level.

Most *epijarbas* species-group taxa are similar in appearance. On the upper surface males are brown with red or orange markings and females are generally plain brown or grey-brown. Both sexes are sombre grey or brown on the under surface, with an arrangement of fine, pale coloured lines. Differences between species are minor and often subtle, but usually constant (but see discussion of *D. viridens* Druce) and are usually associated with underside wing markings and morphology of the male genital armature. Males of Indo-Australian *Deudorix* species previously referred to *Virachola* are structurally similar in all respects to *Deudorix* but have the orange/red upperside coloration replaced by blue.

This is one of a series of papers (Tennent 1997a, b; 1998a, c; 1999a-e; in press a-e; Tennent and Kitching 1998) dealing primarily with the Solomon Islands butterfly fauna and is part of a broader study (Tennent 1998b). The primary aim of the present paper is to make names available for a forthcoming book on the butterflies of the Solomon Islands in which all Solomon Islands taxa, including those illustrated here in monochrome, will be illustrated in colour.

Systematics

Deudorix woodfordi Druce, 1891

(Figs 1, 2, 16, 17, 31)

Description. Markings typical of the *epijarbas* species-group. Frons white; abdomen striped ventrally; male upperside with forewing orange-red patch large, distally more or less 'rounded' in shape, hindwing mainly orange-red, basal areas black; underside brown, forewing with postmedian band extending almost to inner margin (to veins 2 or 1), hindwing with black tornal spot large, round. Genitalia (fig. 31) typical of *Deudorix*; median section of valve sharply angular; apices finger-like, squat. Female upperside dark grey-brown, unmarked; underside as in male.

Distribution. Papua New Guinea (including the Bismarck Archipelago) and the Solomon Islands.

Deudorix viridens Druce, 1891

(Figs 3, 4, 18, 19, 32)

Description. Frons white; abdomen unstriped ventrally; male upperside superficially similar to *D. woodfordi*, orange markings less extensive; underside distinctive in colour and markings, ground colour pale grey-brown, white lines bold, prominent, forewing postmedian band shorter than in *D. woodfordi*, extending from costa to vein 3 (extending to veins 2 or 1 in *D. woodfordi*), space between discal pair of white lines filled chocolate-brown, forming prominent 'square' spot; underside hindwing with tornal and

subtornal markings unlike any other known *Deudorix* species of the region, black spot in space 3 irregular in shape (loosely 'square'), large; distinctive iridescent silvery-green tornal markings. Genitalia (fig. 32) typical of the group; median section of valve distinctly angular. Female upperside atypical of the group, extensively pale blue or lilac blue (variable) (plain brown or grey-brown in all other '*epijarbas*' group species of the region); underside similar to male, paler grey.

Distribution. Solomon Islands (Choiseul and Guadalcanal). Newly recorded from Choiseul.

Deudorix confusa sp. nov.

(Figs 6, 7, 21, 22, 33)

Types. Holotype ♂, SOLOMON ISLANDS, Choiseul, northwest, 3-7 km north of Mole, 40-120 m, 17.iv.1997, W.J. Tennent (gen. prep. BMNH (V) 5123) (BMNH). *Paratypes*: 6 ♂♂, 4 ♀♀, same data as holotype (♂ gen. preps BMNH (V) 5124, 5125, 5126, 5127, 5128, 5129); 3 ♂♂, Choiseul, 19 km (by road) north of Mole, 14.iv.1997, W.J. Tennent (gen. preps BMNH (V) 5130, 5131, 5132); 4 ♂♂, 3 ♀♀, Choiseul, 3-6 km north of Mole, 40-120 m, 16.iv.1997, W.J. Tennent (♂ gen. preps BMNH (V) 5133, 5134, 5135, 5136). PAPUA NEW GUINEA, 3 ♂♂, [Bismarck Archipelago, New Ireland], Herbertshohe, 31.v.[18]94, Dr J. Hagen (including gen. prep. BMNH (V) 1015); 1 ♂, 'New Ireland' (all BMNH).

Description. Resembles *D. woodfordi*, with which it has previously been confused, and *D. epijarbas*. Male forewing length (holotype) 18 mm; upperside red slightly darker than in *D. woodfordi*, less orange than in *D. epijarbas*; underside dark grey-brown (brown in *D. woodfordi*), markings prominent (subdued in *D. epijarbas*), median bands wide, with inner line close to pair of discal marks (median bands narrow, inner line distant from discal marks in *D. woodfordi* and *D. epijarbas*); underside hindwing with pair of parallel white lines in space 7 offset basad (less so in *D. epijarbas* and significantly less so in *D. woodfordi*), orange bordering subtornal spot more extensive than in *D. woodfordi*, often completely enclosing black spot, iridescent tornal markings reduced, blue (silvery-green in *D. woodfordi*). Genitalia (fig. 33) similar to *D. littoralis* Joicey & Talbot; median section of valve rounded (sharply angular in *D. woodfordi* and *D. epijarbas*), apices long and tapering ('squat' in *D. littoralis* and *D. woodfordi* – cf. figs 31c, 33c). Female similar to *D. epijarbas*; upperside hindwing often with traces of orange submarginal markings near tornus; underside similar to male.

Distribution. Papua New Guinea (New Ireland) and Solomon Islands (Choiseul).

Comments. In addition to material collected by the author on Choiseul in 1997, four males of this taxon were located in the BMNH collection in a mixed series over a drawer label '*neopommerana* Ribbe'. Takanami (1989) designated a lectotype for *D. neopommerana* and it is clear from his illustration of this specimen that it is very similar to *D. woodfordi*. D'Abrera

Figs 1-15. *Deudorix* spp., uppersides [HT = holotype; PT = paratype]. (1) *D. woodfordi* ♂ (Guadalcanal); (2) ditto ♀ (Choiseul); (3) *D. viridens* ♂ (HT, Guadalcanal); (4) ditto ♀ (Choiseul); (5) *D. brilligi* ♂ (HT, Choiseul); (6) *D. confusa* ♂ (HT, Choiseul); (7) ditto ♀ (PT); (8) *D. emira* ♂ (HT, Emirau); (9) ditto ♀ (PT); (10) *D. mulleri* ♂ (HT, New Ireland); (11) *D. parsonsi* ♂ (HT, Irian Jaya); (12) *D. tenebrosa* ♂ (HT, Upper Aroa R.); (13) *D. rathsi* ♂ (HT, Dampier I.); (14) *D. eagon* ♂ (HT, Choiseul); (15) *D. wabens* ♂ (HT, Guadalcanal). Scale = 1 cm.

Figs 16-30. *Deudorix* spp., undersides [HT = holotype; PT = paratype]. (16) *D. woodfordi* ♂ (Guadalcanal); (17) ditto ♀ (Choiseul); (18) *D. viridens* ♂ (HT, Guadalcanal); (19) ditto ♀ (Choiseul); (20) *D. brilligi* ♂ (HT, Choiseul); (21) *D. confusa* ♂ (HT, Choiseul); (22) ditto ♀ (PT); (23) *D. emira* ♂ (HT, Emirau); (24) ditto ♀ (PT); (25) *D. mulleri* ♂ (HT, New Ireland); (26) *D. parsonsi* ♂ (HT, Irian Jaya); (27) *D. tenebrosa* ♂ (HT, Upper Aroa R.); (28) *D. rathsi* ♂ (HT, Dampier I.); (29) *D. eagon* ♂ (HT, Choiseul); (30) *D. wabens* ♂ (HT, Guadalcanal). Scale = 1 cm.

(1990), who wrongly attributed authorship of the name *neopommerana* to Staudinger, suggested that it was synonymous with *D. woodfordi* and this was followed by Parsons (1998). A fresh female obtained recently by Chris Muller, from New Ireland, the type locality of *D. neopommerana*, is darker brown on the underside and has much finer markings than *D. woodfordi* females recently collected by the author on Guadalcanal, suggesting that *neopommerana* is at least a distinct subspecies of *D. woodfordi*. The four New Ireland males included here as paratypes of *D. confusa* have a more brown (*i.e.* less grey) underside than males from Choiseul and have tornal iridescent markings green, rather than blue. The male genitalia appear similar in all significant respects to Choiseul specimens and it is not known whether perceived morhological differences are due to the age of specimens or whether New Ireland populations represent a distinct subspecies. Constant differences in underside colour between *D. confusa* and *D. woodfordi* are based on a fresh series of both taxa taken in 1996/1997.

Deudorix emira sp. nov.

(Figs 8, 9, 23, 24, 34)

Types. *Holotype* ♂, PAPUA NEW GUINEA, Squally Island, viii.1923, A.F. Eichhorn (gen. prep. BMNH (V) 5137) (BMNH). *Paratypes*: 15 ♂♂, 7 ♀♀, same data as holotype (including ♂ gen. preps BMNH (V) 1059, 5138) (all BMNH).

Description. Male forewing length (holotype) 17 mm; resembles *D. confusa* and *D. epijarbas* but smaller, the hindwing tail short (longer in *D. epijarbas* and *D. confusa*); male upperside distinctive, the red or orange-red colour of most *epijarbas* species-group taxa replaced by dull purplish-orange; underside less grey than in *D. confusa*, subtornal spot small, underside markings subdued (more prominent in *D. confusa*). Genitalia (fig. 34) typical of group; median section of valve similar to *D. viridens* (fig. 32) and *D. epijarbas*; valve apices similar to *D. confusa* (fig. 33). Female underside brown (grey brown in *D. confusa*), markings similar to *D. confusa*.

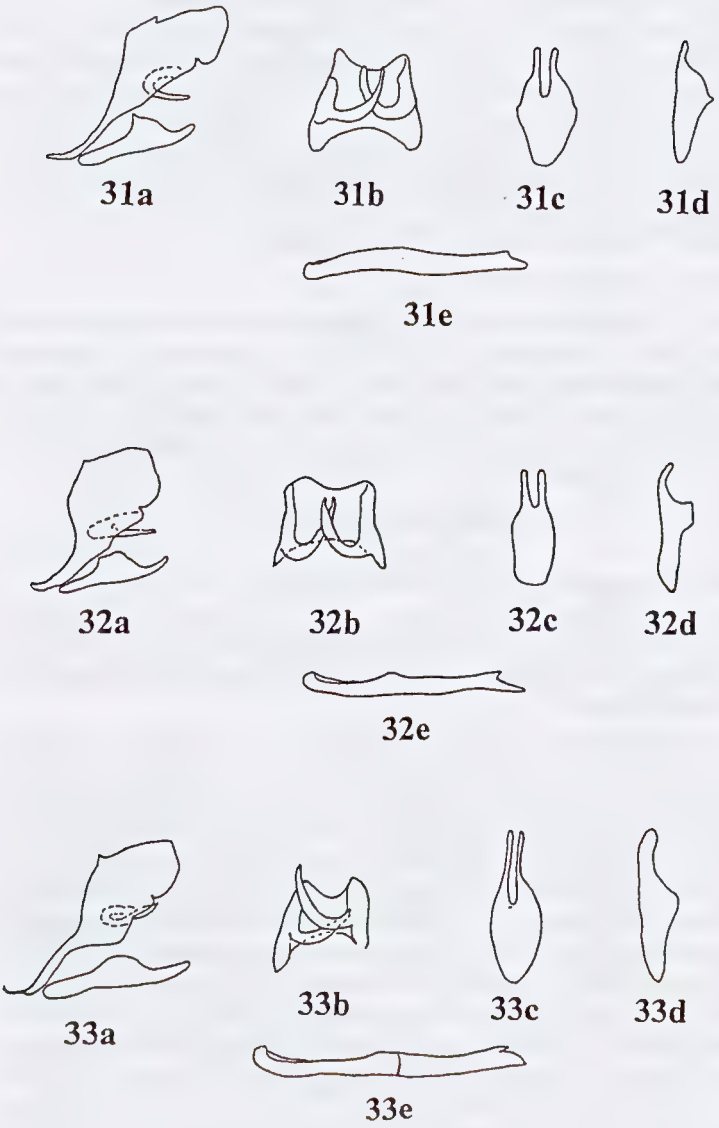
Distribution. Papua New Guinea (Bismarck Archipelago: Emirau).

Comments. Squally Island, now more usually referred to as Emirau or Emira, is part of the St. Matthias island group in the Bismarck Archipelago. Parsons (1998) reported *D. epijarbas* from Squally Island, based on this series in the BMNH. Although these specimens do bear a superficial resemblance to *D. epijarbas*, particularly the underside markings, the distinctive colour of the male upperside, combined with differences in genitalia (cf. Parsons 1998, plate XIV for *D. epijarbas*), suggest a separate species.

Deudorix brilligi sp. nov.

(Figs 5, 20, 35)

Type. *Holotype* ♂, SOLOMON ISLANDS, Choiseul, northwest, 3-7 km north of Mole, 40-120 m, 17.iv.1997, W.J. Tennent (gen. prep. BMNH (V) 5140) (BMNH).



Figs 31-33. *Deudorix* male genitalia: a, genitalia, aedeagus removed (lateral view); b, uncus (posterior view); c, valvae (posterior view); d, right valva (lateral view); e, aedeagus (lateral view). (31) *D. woodfordi*; (32) *D. viridens*; (33) *D. confusa*.

Description. Male forewing length 17 mm; a distinctive species with superficial resemblance to *D. viridens*; upperside forewing with red patch broader, shorter (more squat), hindwing with red patch more extensive, reaching costa, leaving distinctly angular black basal patch; underside similar to *D. viridens*, forewing with post median lines fine, regular, reaching to vein 1 (more prominent, irregular, less extensive in *D. viridens*), hindwing with pair of parallel white lines in space 7 offset basad (part of curved median series in *D. viridens*), subtornal iridescent markings blue-green (silvery-green in *D. viridens*). Genitalia (fig. 35) similar to *D. woodfordi* (fig. 31); dorsal indentation of tegumen deep (shallow in *D. woodfordi*). Female unknown.

Distribution. Solomon Islands (Choiseul).

Comments. The female of this taxon is unknown and when material becomes available it will be interesting to see whether it is brown on the upperside, like most *epijarbas* species-group species in the region, or blue like the female of *D. viridens*. A female with underside markings similar to those of *D. viridens* and *D. brilligi*, but with an apparently brown upperside, was one of several *Deudorix* specimens seen on Choiseul, but not captured.

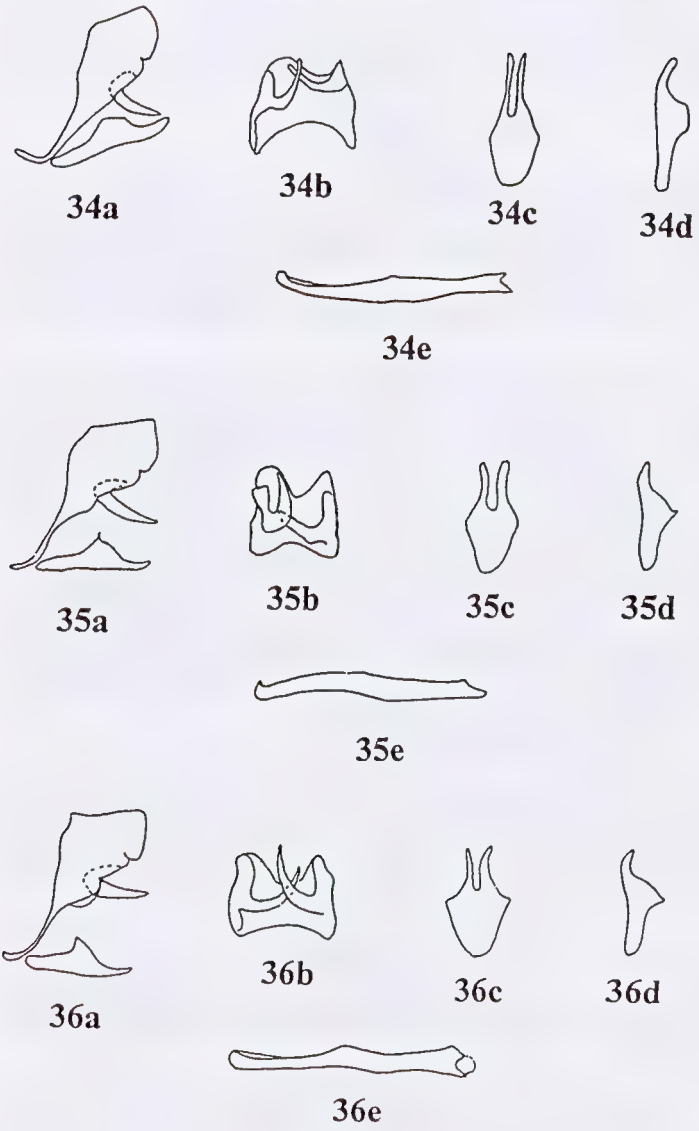
Deudorix tenebrosa sp. nov.

(Figs 12, 27, 36)

Deudorix species a; Parsons, 1998: 405, pl. XIV, pl. 62, figs 1702-1705.

Types. Holotype ♂, PAPUA NEW GUINEA, Central Province, Upper Aroa River, i-iv.[19]03, A.S. Meek, (gen. prep. BMNH (V) 1024) (BMNH). *Paratype* ♀, Central District, Itikinumu Ridge, 600 m, 31.vii.1973, T. Fenner (PNG National Insect Collection, Port Moresby).

Description. Male forewing length 17 mm; antenna with white patch below club ventrally; frons orange; abdomen unstriped ventrally (Parsons 1998 – not available to present author; abdomen already removed for dissection); upperside with orange markings reduced in relation to other members of the *epijarbas* species-group, forewing with orange area reduced to a small dull patch in space 1b above inner margin, hindwing with orange area reduced to several elongated markings; underside brown, pale lines bold (prominent), forewing with postmedian band prominent, straight, reaching vein 1, 'outer' line of parallel pair of discal lines confluent with the 'inner' line of postmedian series nearest the costa (separated in all other *epijarbas* species-group taxa examined), hindwing with postmedian band irregular, with pair of white lines nearest the costa displaced basad, tornal lobe large, subtornal spot small, bordered orange basad, iridescent tornal markings blue-green, confined to broken, irregular subtornal line and some scales basad to subtornal spot. Genitalia (fig. 36) similar to *D. woodfordi* (fig. 31); dorsal indentation of tegumen less shallow; anterior/posterior slope on median section of valve unequal (more-or-less equal in *D. woodfordi*). Female upperside 'notably grey-brown' (Parsons 1998); underside as in male.



Figs 34-36. *Deudorix* male genitalia: a, genitalia, aedeagus removed (lateral view); b, uncus (posterior view); c, valvae (posterior view); d, right valva (lateral view); e, aedeagus (lateral view). (34) *D. emira*; (35) *D. brilligi*; (36) *D. tenebrosa*.

Distribution. Papua New Guinea.

Comments. The male holotype and female paratype of this taxon were illustrated by Parsons (1998). The latter has not been examined by the present author.

Deudorix parsonsi sp. nov.

(Figs 11, 26, 37)

Deudorix species b; Parsons, 1998: 406, pl. XIV, pl. 62, figs 1706-1709.

Types. Holotype ♂, INDONESIA, western Irian Jaya, Kapaur [near Fak Fak (Parsons 1998)], Low c. [?], xii.[18]96-i.[18]97, Doherty (gen. prep. BMNH (V) 1023) (BMNH). *Paratype* ♂, PAPUA NEW GUINEA, Western province, Kiunga, Fly River, 2.vii.-31.x.1957, W.W. Brandt (Australian National Insect Collection, Canberra).

Description. Male forewing length 18 mm; typical of the *epijarbas* species-group; similar to *D. tenebrosa*; frons orange; abdomen unstriped ventrally (Parsons 1998 – not available to present author: abdomen already removed for dissection); upperside forewing with orange patch larger, paler (but still reduced in comparison to other *Deudorix* species), hindwing with orange area more extensive, dull; underside pale brown (pale grey-brown in *D. tenebrosa*; the greenish colour of Parsons 1998, plate 62, fig. 1709 is misleading), forewing with lines less bold, discal pair separate from postmedian series ('outer' line confluent with postmedian band in *D. tenebrosa* – cf. figs 26, 27), sub tornal spot thinly but completely circled orange. Genitalia (fig. 37) like *D. tenebrosa* (fig. 36); median section of valve angular; aedeagus shorter. Female unknown.

Distribution. Indonesia (Irian Jaya) and Papua New Guinea.

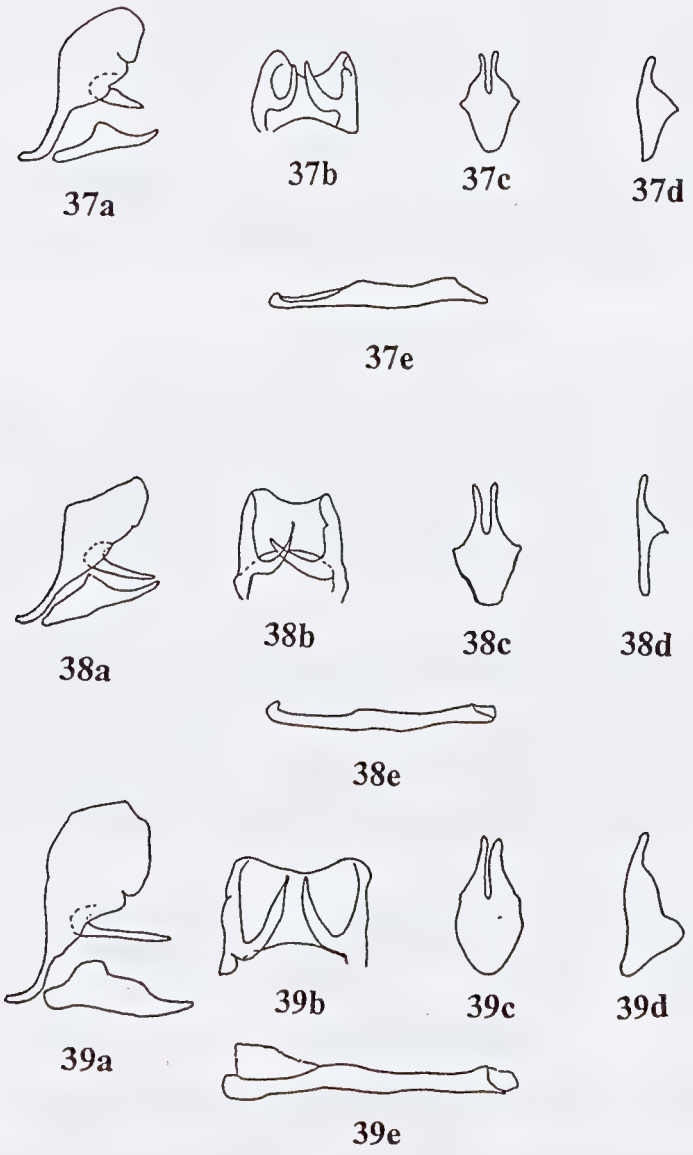
Comments. The female of this taxon is unknown; reference to features of both sexes by Parsons (1998) was presumably a typographical error. The taxon is named after Mike Parsons, whose contribution to the knowledge of the New Guinea butterfly fauna has been very significant.

Deudorix mulleri sp. nov.

(Figs 10, 25, 38)

Type. Holotype ♂, PAPUA NEW GUINEA, Bismarck Archipelago, central New Ireland, Schleinitz mountains, 1260 m, 24.vii.1998, C.J. Muller (gen. prep. BMNH (V) 5139) (BMNH).

Description. Male forewing length 16 mm; similar to *D. tenebrosa* but darker; antenna with white patch below club ventrally; frons white (orange in *D. tenebrosa*); abdomen striped ventrally (unstriped in *D. tenebrosa*); upperside forewing with orange patch more extensive, hindwing with orange markings broadly broken by veins, concentrated on tornal section of wing (more extensive in apical section in *D. tenebrosa*), tornal lobe smaller; underside grey-brown (paler, less grey in *D. tenebrosa*), forewing with white



Figs 37-39. *Deudorix* male genitalia: a, genitalia, aedeagus removed (lateral view); b, uncus (posterior view); c, valvae (posterior view); d, right valva (lateral view); e, aedeagus (lateral view). (37) *D. parsonsi*; (38) *D. mulleri*; (39) *D. rathsi*.

lines finer, the discal pair separate from postmedian series, hindwing with pair of postmedian lines closer together, less displaced than in *D. tenebrosa*, tornal iridescent markings blue-green, extensive, subtornal spot large. Genitalia (fig. 38) like *D. tenebrosa* (fig. 36); valve apices longer, less squat; aedeagus longer, more slender. Female unknown.

Distribution. Papua New Guinea (New Ireland).

Comments. This distinctive butterfly is named after Chris Muller of Dural, New South Wales, who collected the unique holotype and whose efforts in the field under difficult conditions on New Ireland has resulted in many significant new discoveries.

Deudorix rathsi sp. nov.

(Figs 13, 28, 39)

Deudorix species c; Parsons, 1998: 406, pl. XIV, pl. 62, figs 1710-1713.

Types. Holotype ♂, PAPUA NEW GUINEA, Dampier Island, ii.&iii.1914, [Meek's Expedition] (gen. prep. BMNH (V) 1016) (BMNH). *Paratypes*: 1 ♂, Vulcan Island, xi.1913-i.1914, [Meek's Expedition] (gen. prep. BMNH (V) 1115) (BMNH); 1 ♂, 6 km S[outh] E[ast] of Bulolo, Pinetops Bridge, Bulolo river gorge exit, 730 m, 22.xi.1973, Thomas W. Davies (California Academy of Sciences Collection, San Francisco, USA [CAS]); 1 ♀, Watit r[iver] gorge, 8 km W[est] of Bulolo, 600 m, 27.viii.1972, T.W. Davies (CAS).

Description. Male forewing length 18 mm; similar to *D. woodfordi* and *D. confusa*; upperside with markings pale orange (red in *D. woodfordi* and *D. confusa*); underside typical of the *epijarbas* species-group; pale brown (darker brown in *D woodfordi.*, grey-brown in *D. confusa*; the greenish-tinged colour of Parsons 1998, plate 62, fig. 1711 is misleading), white lines prominent. Genitalia typical of the group but distinctively large; dorsal indentation of tegumen shallow; valve long, irregular in shape; aedeagus long. Female upperside dark brown (Parsons 1998); underside as in male.

Distribution. Papua New Guinea.

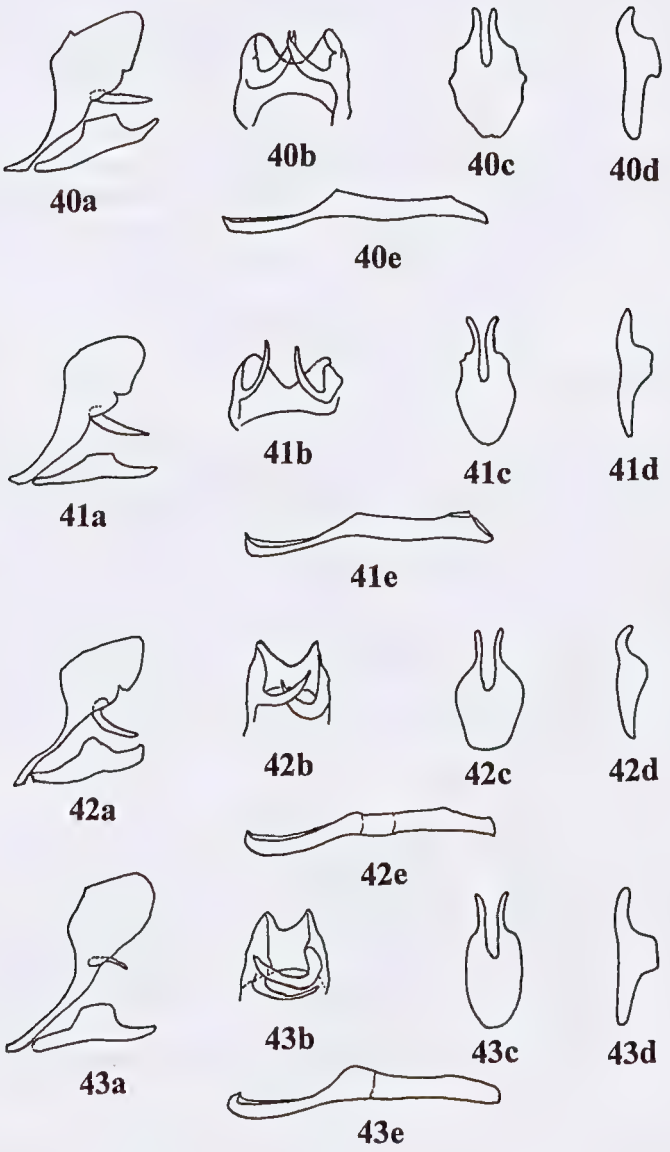
Comments. The male holotype and female paratype of this taxon were illustrated by Parsons (1998). The latter has not been examined by the present author.

Deudorix eagon sp. nov.

(Figs 14, 29, 42)

Type. Holotype ♂, SOLOMON ISLANDS, Choiseul, northwest, 3-7 km north of Mole, 40-120 m, 17.iv.1997, W.J. Tennent (gen. prep. BMNH (V) 5141) (BMNH).

Description. Male forewing length 15 mm; resembles the male usually associated with the female holotype of *Deudorix (Virachola) affinis* Rothschild (see discussion); upperside with cobalt blue (bright silvery-blue in '*D. affinis*') less extensive on both fore and hindwings, tornal markings not possible to assess due to wing damage; underside grey-brown (brown in



Figs 40-43. *Deudorix* male genitalia: a, genitalia, aedeagus removed (lateral view); b, uncus (posterior view); c, valvae (posterior view); d, right valva (lateral view); e, aedeagus (lateral view). (40) *D. democles*; (41) '*D. affinis*'; (42) *D. eagon*; (43) *D. wabens*.

'*D. affinis*'); arrangement of fine lines like '*D. affinis*', hindwing with pale (off-white) patch reduced, underlying markings distinct (patch white, extensive, obscuring underlying markings in '*D. affinis*'). Genitalia (fig. 42) similar to '*D. affinis*' (fig. 41); valve median lobe smaller, less angular, dorsal indentation of tegumen more shallow. Female unknown.

Distribution. Solomon Islands (Choiseul).

Comments. This taxon is named in recognition of the staff of the Eagon Resources Development Company (S.I.), who were generous in providing hospitality and transport for the author on Choiseul island, without which several new taxa described in this paper would not have been discovered.

Deudorix wabens sp. nov.

(Figs 15, 30, 43)

Virachola democles affinis; Parsons, 1998: 410, pl. 63, figs 1737, 1738 [misidentification].

Types. Holotype ♂, SOLOMON ISLANDS, Guadalcanal, [Mount] Gallego, vegetation around camp 2, 13.vii.1965, Royal Society Expedition (gen. prep. BMNH (V) 5142) (BMNH). *Paratype* ♂, Guadalcanal, Betikama river, 6.viii.-2.x.1960, W.W. Brandt (Australian National Insect Collection (ANIC), Canberra).

Description. Male forewing length 19.5 mm; superficially resembles '*D. affinis*' and *D. eagon* above but larger, the forewing longer and apex more angular; upperside markings dull steely-blue (shining silvery-blue in '*D. affinis*', cobalt blue in *D. eagon*); underside resembles *D. eagon*, the markings less regular, hindwing with pale patch more extensive. Genitalia (fig. 43) typical of *Deudorix*; median lobe of valve large, flattened (less broad in '*D. affinis*' [fig. 41], rounded in *D eagon* [fig. 42]); valve apices long. Female unknown.

Distribution. Solomon Islands (Guadalcanal).

Comments. The paratype male was illustrated by Parsons (1998) as *Virachola democles affinis*. The explanation for this arrangement relates to a cabinet drawer note in the ANIC, Canberra, made by the late G. E. Tite, who suggested that the specimen might be associated with the Australian taxon *D. democles* Miskin, which Tite knew only from the illustrations of Waterhouse and Lyell (1914). Although clearly related to *D. democles* (and other 'blue' *Deudorix* taxa), both the phenotype and the male genitalia (cf. fig. 40 [*D. democles*] and fig. 43 [*D. wabens*]) suggest that they are not conspecific.

Discussion

Two *Deudorix* species, *D. woodfordi* and *D. viridens*, were described from the island of Guadalcanal by Druce (1891) but there appear to be no published reports of any other species from the Solomon Islands prior to Parsons (1998). There is a female in the collection of The Natural History

Museum, London (BMNH), taken by Meek in 1904 on Rendova (New Georgia Group), which represents a third taxon, almost certainly *D. diovis* Hewitson and a female taken on Alu (Shortland group) in November 1997 also corresponds closely to this taxon. No corresponding male '*D. diovis*' from the Solomon Islands has been seen. Parsons (1998) additionally reported *D. epijarbas concolor* Joicey & Talbot from the large island of Bougainville, politically part of Papua New Guinea but geographically and faunistically part of the Solomons Archipelago, and reported *D. wabens* (as *Virachola democles affinis*) from Guadalcanal.

The large, mountainous and poorly explored island of Choiseul, southeast of Bougainville, was visited in April 1997, at the start of a period of cyclonic conditions. In the calm following several days of heavy rain and high winds, lycaenid butterflies were attracted in unusually large numbers to the small white flowers of a *Mikania* species (Asteraceae) and a total of 24 *Deudorix* specimens (usually seen only singly or in small numbers in the Solomon Islands), of both sexes, were collected. This material comprised five species, of which three are described as new in this paper. Although the possibility of dispersal between islands as a result of the cyclonic conditions is not discounted, the number of species flying together (*D. woodfordi, D. viridens, D. confusa, D. brilligi, D. eagon*), together with a general lack of available material, suggests that adult *Deudorix* species may be primarily canopy dwellers, 'forced' lower on this occasion to feed at flowers after several days of inactivity. These butterflies are extremely fast fliers and the number of individuals collected on Choiseul represents only a percentage of those seen. It is not known whether the sample included all species present.

Of the two previously reported Solomon Islands species, *D. woodfordi*, regarded as a subspecies of *D. epijarbas* by some authors (e.g. Samson 1980), is known to be widespread and sympatric with *D. epijarbas* in the New Guinea region, including the Bismarck Archipelago and Bougainville. In comparison, the highly distinctive *D. viridens*, provisionally placed with *D. epijarbas* by Seitz (1926) and overlooked by D'Abrera (1971, 1978, 1990), has been largely ignored in the literature. Parsons (1998) briefly mentioned *D. viridens*, stating that it flew with *D. woodfordi* on Guadalcanal. It is not actually known whether the taxa are sympatric on that island, since *D. viridens* appears to have been collected there only sporadically since it was first described.

Druce (1891) described *D. viridens* from the male, which he stated was 'strongly dusted over both wings with light green scales' and it is clear from Druce's type material in the BMNH, and the few further specimens accumulated since that time, that it is a distinctive, but variable species. The male holotype is small, with a prominent blue-green sheen on the upper surface, a feature present to a lesser degree on several other males examined. Further males are large and completely lack this sheen, although the distinctive underside markings and genitalia of all specimens examined

including the holotype and a large male at the opposite end of the range of variation, also from Guadalcanal, appear identical. Aside from a series of 11 males and 9 females in the ANIC, the female of *D. viridens* is not present in any collection seen and is reported here for the first time. The ANIC series, taken on Guadalcanal by the late William Brandt, is remarkable in terms of both the number of specimens and the pristine condition of all individuals, suggesting they may have been reared from the early stages, although there is no record of such an event in Brandt's notes (Ted Edwards, pers. comm.). It is interesting that none of the 11 males in this series has Druce's green sheen and it is possible that further study may reveal the presence of more than one taxon under what is presently considered to be *D. viridens*.

As already noted under *D. wabens*, Parsons (1998) placed *Deudorix affinis* Rothschild, stat. rev. as a subspecies of *D. democles* Miskin from Australia and incorrectly associated and illustrated a male from Guadalcanal as *Virachola democles affinis*. The status of *D. affinis* itself is open to question and it is by no means certain that a male historically associated with the female holotype belongs to that taxon. The holotype, illustrated by D'Abrera (1990) and Parsons (1998), was taken on Dampier (Karkar) island, north of Madang (Papua New Guinea) in 1914 by Meek (Rothschild 1915). A male, illustrated by D'Abrera (1990) as *D. affinis*, was taken on Sudest (Tagula) island, the largest of the Louisiades, in 1916 by the Eichhorn brothers. The two localites are more than 1200 km apart and it is possible, even probable, that these specimens are not conspecific. Including two new taxa described above, males of three different 'blue' *Deudorix* are known, from Papua New Guinea, Choiseul and Guadalcanal. No female is known from any of these localities and it is uncertain whether any of these males may be associated with the female holotype of *D. affinis*. Based on underside coloration and markings, the Sudest male is the most similar, but only examination of a male from Dampier, or a female from Sudest, will provide a definitive answer. Comparison of female *D. democles* with the holotype of *D. affinis*, and of the genitalia of male *D. democles* (fig. 40) with the Sudest '*D. affinis*' (fig. 41), suggests a close relationship, but not conspecificity, in each case. The Guadalcanal male illustrated by Parsons (1998) [*D. wabens*] is the least likely of the possible contenders for the true male of *D. affinis*.

As the foregoing illustrates, the New Guinea sub-region *Deudorix* species are a very complex group of butterflies which are not well understood and this may account for the significant differences seen in taxonomic judgement and interpretation. The group is very much in need of extensive revision.

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SYNONYMY, GEOGRAPHIC DISTRIBUTIONS, LECTOTYPE DESIGNATIONS AND TYPE DEPOSITORIES OF SOME AUSTRALIAN AND SOUTH PACIFIC DACINAE (DIPTERA: TEPHRITIDAE)

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Abstract

Bactrocera (Bulladacus) neotigrina Drew & Hancock, from north-eastern Queensland, is placed as a new synonym of *B. (Bulladacus) flavinotus* (May), comb. nov., which is removed from synonymy with *B. (Bulladacus) tigrina* (May). Corrected geographic distributions are provided for ten species of *Bactrocera* Macquart from the South Pacific. Lectotype designations for *B. curvipennis* (Froggatt) and *Dacus ornatissimus* Froggatt are discussed and notes on type depositories provided.

Introduction

Some species of Dacinae in the South Pacific region are major pests of a wide range of horticultural crops. Besides crop losses incurred, many countries experience quarantine restrictions to export trade in fresh horticultural produce. Consequently, it is essential that published geographic distributions are correct. Extensive fruit fly surveillance programmes that have included 22 Pacific Island countries, from 1990 to the present, have provided comprehensive data on geographic distributions and host plant records of most known species (Allwood and Drew 1997). Some incorrect distributions were listed by Norrbom *et al.* (1998), together with incorrect deductions on lectotype designations and queries on type depositories. This paper discusses the necessary corrections to several species of *Bactrocera* Macquart.

When Drew *et al.* (1999) described *Bactrocera neotigrina* Drew & Hancock from north-eastern Queensland, an earlier name by May (1958) unfortunately was overlooked, being included at that time in the synonymy of *B. tigrina* (May). The resulting synonymy is detailed below.

New synonymy

Bactrocera (Bulladacus) flavinotus (May), comb. nov.

Afrodacus flavinotus May, 1958: 293. Type locality Atherton, Qld. Holotype ♀ in Queensland Museum, Brisbane [examined].

Bactrocera (Bulladacus) neotigrina Drew & Hancock, in Drew *et al.*, 1999: 7. Type locality Helenvale, Qld. Holotype ♂ in Queensland Museum, Brisbane [examined]; syn. nov.

Comments. This species was described by May (1958) from a single specimen, considered to be teneral by Drew (1989), who incorrectly synonymised it with *B. tigrina*. It is here removed from synonymy, differing from *B. tigrina* in characters noted by Drew *et al.* (1999), particularly the

mostly fulvous scutum in both sexes and the very weakly indicated bulla on the wing in males.

Geographic distributions

The distributions of the following ten South Pacific species of *Bactrocera* Macquart were incorrectly or incompletely indicated by Norrbom *et al.* (1998).

Bactrocera curvipennis (Froggatt)

Recorded only from New Caledonia and not Fiji (see notes below under lectotype designations). A record from Vanuatu (Aneityum, November 1930: see Drew 1989) is unconfirmed and doubtful; it has not been detected on any Vanuatu island in recent surveys.

Bactrocera distincta (Malloch)

Recorded from Fiji, Futuna, Niue, Tonga and Samoa (American and Western).

Bactrocera facialis (Coquillett)

Recorded only from Tonga and not New Caledonia.

Bactrocera kirki (Froggatt)

Recorded from French Polynesia, Futuna, Niue, Tonga, Samoa (American and Western) and Wallis.

Bactrocera musae (Tryon)

Recorded from north-eastern Queensland (Australia) and mainland Papua New Guinea. Its presence in the Bismarck Archipelago is unconfirmed, while reports from the Solomon Islands are doubtful and unconfirmed and reports from Vanuatu are incorrect.

Bactrocera paraxanthodes Drew & Hancock

Recorded only from New Caledonia. Records from Vanuatu and Western Samoa (see Drew and Hancock 1995) refer to undescribed sibling species.

Bactrocera passiflorae (Froggatt)

Recorded from Fiji, Niue, Tuvalu and Wallis. Typical *B. passiflorae* has never been reared from fruit samples in Tonga and a morphologically similar population in the northern Tongan islands of the Niua group (see Drew and Hancock 1995) is probably an undescribed sibling species.

Bactrocera psidii (Froggatt)

Recorded only from New Caledonia and not from Tonga and Western Samoa.

Bactrocera simulata (Malloch)

Recorded from Papua New Guinea (Bougainville) and the Solomon Islands. A record from Vanuatu appears to be a misidentification of another species.

Bactrocera xanthodes (Broun)

Recorded from Cook Islands, Fiji, Samoa (American and Western), Tonga, Wallis and Futuna.

Lectotype designations

The lectotype designations for *Bactrocera curvipennis* (Froggatt) and *Dacus ornatissimus* Froggatt by Drew (1989) were declared invalid by Norrbom *et al.* (1998). However, these lectotype designations are valid and the reasons for this are given below. As noted by Drew (1974), Froggatt often confused the locality records of his type material in print but had the correct data on the specimen labels. For example, Froggatt (1909) described *Dacus ornatissimus* and *Dacus curvipennis* on the same page but incorrectly, under habitat, listed the locality and host of *D. curvipennis* under *D. ornatissimus* and vice versa.

Bactrocera curvipennis (Froggatt)

The types of this species are in the New South Wales Agriculture Collection. They are correctly labelled 'syntype, New Caledonia, bred ex mandarins, October 1901, coll. Mr Butler'. Drew (1989) correctly designated one of the two types as the lectotype and the other as a paralectotype. In the original description, Froggatt (1909) incorrectly listed the habitat and host data of *B. curvipennis* as Fiji, ex bananas, the correct data having been listed in error under *Dacus ornatissimus*. It is important to note that *B. curvipennis* has never been recorded from Fiji, only from New Caledonia.

'Dacus' ornatissimus Froggatt

The types of this species are also in the New South Wales Agriculture Collection. As explained by Drew (1974, 1989), the type series consists of two species, *Bactrocera psidii* (Froggatt) (bred from guava from New Caledonia) and *B. musae* (Tryon) (bred from banana from Australia, not Fiji as originally stated). The lectotype (labelled type) was correctly designated by Drew (1989) and is the only specimen of *B. psidii*, while the paralectotypes (labelled cotypes) are all specimens of *B. musae*. The illustrations by Froggatt (1909) are of *B. musae*. The lectotype is labelled 'New Caledonia, 4.4.97, bred guava, type WWF' and it is probable that this is also an unlabelled syntype of *B. psidii*, described from material from the same source. It may have been included inadvertently in the type series of *D. ornatissimus* but appears to be the specimen specified as the 'type' by Froggatt (1909) but listed incorrectly, along with habitat and host data, under *D. curvipennis*. The confusion caused by Froggatt in the handling and recording of these type specimens was discussed in detail by Drew (1974). Neither *B. psidii* nor *B. musae* has ever been recorded from Fiji and *B. musae* never from New Caledonia. As in the case of the syntypes of *B. curvipennis*, the syntypes of *D. ornatissimus* were correctly labelled by Froggatt.

Type depositories

Norrbom *et al.* (1998) recorded the present location of the types of several *Bactrocera* species as uncertain. However, their current status is indicated below (see Drew 1989).

In New South Wales Agriculture Collection (NSWA): *B. curvipennis* (Froggatt); *B. ornatissimus* (Froggatt).

Probably in NSWA: *B. psidii* (Froggatt) [see above under '*Dacus' ornatissimus*].

Unknown, probably lost: *B. cucumis* (French), *B. frenchi* (Froggatt); *B. nigrofasciatus* (Tryon), *B. pepisalae* (Froggatt); *B. rarotongae* (Froggatt); *B. tongensis* (Froggatt); *B. tryoni* (Froggatt).

Lost: *B. xanthodes* (Broun).

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CORRECTIONS TO AN ANNOTATED LIST OF THE HAWK MOTHS (LEPIDOPTERA: SPHINGIDAE) OF WESTERN PROVINCE, PAPUA NEW GUINEA

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Abstract

Previous records of *Macroglossum mitchelli* (Boisduval) and *M. albigutta* Rothschild & Jordan from Western Province, Papua New Guinea are misidentifications of *M. stevensi* Clark and an undescribed species, respectively.

Discussion

In a paper on the hawk moths of Western Province, Papua New Guinea by Moulds and Lachlan (1998), two species were misidentified.

The specimens identified as *Macroglossum mitchelli* (Boisduval) are, in fact, *Macroglossum stevensi* Clark. The specimens identified as *Macroglossum albigutta* Rothschild & Jordan are not this species and belong to an undescribed species (Lachlan and Kitching, in prep.).

Tennent and Kitching (1998) clearly figure specimens of both *M. a. albigutta* and *M. a. floridense* Rothschild & Jordan and these do not match the specimens figured in Moulds and Lachlan (1998).

Dr Ian Kitching (The Natural History Museum, London) kindly brought these identification errors to our attention and noted that there were only three specimens of *M. stevensi* known prior to the publication of Moulds and Lachlan (1998). We thank him for bringing this to our notice.

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